A CONNECTION BETWEEN ALGEBRA AND LIFE.

By Elizabeth G. White.

Can algebra be made a vital subject of real value to every student? Can it be made an instrument to prepare each student for his life problems? Questions like these must confront every teacher who is not so blinded by the glittering generalities of formal discipline that he can not see the issues that count. The task seems hopeless when one turns to the pages of a standard textbook and finds such questions as the following: "Three times the excess of a certain number over eight is equal to twice the number plus one. Find the number." Of what possible interest is such a problem? What connection can its solution have with any of the life situations the student will meet? A buoyant teacher may infuse into it an interest; by the force of her personality she may keep it from seeming the dry bones that it really is. A better type of question perhaps is the following, but it failed to arouse any interest in the class to which it was presented: "At an election there were two candidates and 1,280 votes were cast. The successful candidate had a majority of 40. How many votes were cast for each candidate?" This question was given to a class of first-year high-school students in the fall of the present year when the approaching presidential election was a matter of interest. As the teacher turned to this question in her textbook she thought, "Here is a problem within the experience of my students." The girl who was asked to solve it read it five times and then had no idea of the equation. When asked why she could not do it, she said, "I don't know anything about voting." That was the point, she knew nothing about voting, and there was no connection in her mind between the problem and current events which could arouse a desire to know.

On November 7, 1916, a first-year class came to its algebra room; there was suppressed excitement in the air, the feverish interest that permeated the American body politic had pene-

trated into this class room. The teacher put the following question on the blackboard, the data for which she had acquired at the noon lunch hour by phoning a downtown office:

"At noon to-day Mr. Hughes had three less electoral votes than Mr. Wilson. If there were 42 votes still to be heard from, how many votes had each candidate at that hour?"

When told that the answer to the problem would give the actual returns at noon, the class fell upon it, each eager to know the chances of her candidate. Some students did not know the total number of electoral votes; the correct number, 531, was supplied by a student and the problem was soon solved by the class. The teacher then made a question which was not based on actual facts; she trusted to the interest already aroused to carry it through, and was not disappointed. The question was as follows:

At 12 o'clock midnight on November 7, 1916, Mr. Hughes had 6/5 as many electoral votes as Mr. Wilson. At 1 A. M. each received 10 more votes, at 2 A. M. Hughes received 6 and Wilson 7, at 4 A. M. Hughes received 2 and Wilson 10, and at 5 A. M. Hughes received the remaining votes, which were 35. How many votes had each candidate at midnight?

The point in algebraic manipulation which the class lesson aimed to give was the method of handling a fractional equation. Most members of the class solved the last problem by letting $6x =$ number of votes Hughes had, and $5x =$ number of votes Wilson had. The teacher asked for a fractional expression, and received the statement,

Let $x =$ number of votes Wilson had, and

$\frac{6x}{5} =$ number of votes Hughes had.

This introduced the fractional equation which is handled by the axiom "If equals are multiplied by equals the products are equal." The remainder of the class lesson was spent in solving problems involving fractional equations, which were found in the textbook, and the home work assignment consisted of problems of the same character.

On the following day students were asked to make some problems on the election returns. November 8 was the day, and students were eagerly waiting for returns, as were all Ameri-

cans. In a few minutes six or seven problems were ready. The following are some of the problems made by the students:

1. On November 9, 1916, the morning papers showed that Woodrow Wilson had 12 electoral votes more than Charles Hughes. If 41 electoral votes had not been accounted for, how many votes had each of the candidates on that morning?

2. In an election Mr. Wilson has 4/5 as many electoral votes as Mr. Hughes. If Hughes should get 48 more electoral votes he would have twice as many as Mr. Wilson. How many votes has each?

3. On November 8, 1916, the evening paper said that Woodrow Wilson had 21 more votes than Charles Hughes. If 20 electoral votes had not been counted, how many had each of the candidates on that night, the total amount of electoral votes being 531.

4. On November 8, 1916, the papers showed that Mr. Wilson had 6/5 as many votes as Mr. Hughes. If one hour later Mr. Wilson receives 20 votes and Mr. Hughes 15, 45 not being accounted for, how many votes did they each have that morning?

5. On November 8, 1916, Mr. Wilson had 10 more electoral votes than Mr. Hughes. If 39 electoral votes had not been accounted for, how many votes had each?

6. On November 9, 1916, papers showed that Mr. Hughes received 30 more votes than Mr. Wilson. If 5 votes had not been cast yet how many votes has each now?

One student had brought data concerning the states not heard from. She wrote out the following problem which she gave to the class in a most delightful manner:

This morning's paper says that Wilson has 12 more electoral votes than Hughes. At 10 A. M. Wilson carries California, which has 13 electoral votes, and, at the same time, Hughes carries Minnesota, which has 12 electoral votes. At 11 A. M. Wilson carries North Dakota, which has 5 electoral votes, and New Mexico, which has 3. At 12 noon Hughes carries West Virginia, which has 8 electoral votes. If this completes the returns, how many electoral votes did each candidate have before the returns from these five states came in? After the returns from these five states came in?

This question showed very clearly where her interest in the

election lay. The five states not heard from she handled in such a way that her candidate would be successful. When she came to the statement that West Virginia had gone for Hughes, she turned to the teacher and confidentially said, "I am sure West Virginia will go Republican." Thereupon others in the class expressed a similar opinion. Algebra, remote, abstract algebra, had become connected with life, with the very heart life of the American people, and its signs and symbols were used to solve that most interesting of all problems, "Who is elected?"

Since questions of current interest when made by students are easily solved, a certain method of handling them is necessary in order that definite aims may be accomplished. The aims of such a lesson are:

1. To place the work within the experience of the student, thus furnishing a basis for interest.
2. To furnish a natural starting point for more difficult problems, with their necessary mechanical manipulation.
3. To arouse student initiative in making problems.
4. To give facility in translating rapidly and correctly the words of a problem into the symbols of an algebraic equation.

This last aim is accomplished by what is known as a "Problem Game." In playing this game a student reads, clearly and slowly, a problem she has made, while the class immediately writes the equation which will express the facts given. The class does not copy the words of the problem, but writes the algebraic symbols which stand for the words, just as a stenographer writes shorthand from dictation. The problems are usually simple enough to permit of this rapid translation. Every student in the class must be ready with a problem in order to play the game; a student forfeits three points when she cannot respond when called on. The aim is accomplished by this very act of making a problem. Making a problem is like getting on the inside and looking out. The mysterious man who makes textbooks has been forcing his problems upon the innocent student ever since he took his first arithmetic book in hand. Here is a different viewpoint, the student now has a chance to get back of the scenes, to juggle the symbols

himself and turn out something worth solving. The algebraic processes and symbols become more familiar when handled from this viewpoint.

The Problem Game may be briefly described as follows:

Rules for the Problem Game.

1. Teacher chooses student to read a problem which student has made.

2. Class and teacher write the equation at their desks as the student reads her problem to them, just as a stenographer writes shorthand from dictation.

3. The student who first finishes the problem refers it to the teacher, and if it is correct her name is placed on the score board with the mark (2).

4. This student then becomes the time-keeper.

5. The students solving the problem correctly within the next two minutes place their names on the score board with the mark (1).

6. If a student makes a problem incorrectly she receives the mark (—1).

7. The student first arriving at the correct solution calls upon another student to read the next problem, thus the game is thrown into the hands of the students. The teacher's part is to see if the problems are correctly made and solved.

Score of Problem Game Played by Students of a First-Year Algebra Class, November 10, 1916.

Name of student making problem I: Ray Zest (2).

Name of student first correctly solving problem 1: Grace Stack (2).

Names of students solving problem 1 correctly within next two min.: Regina Stack (1), Bertha Wyner (1), Phyllis Tyrrill (1), Mae Shockey (1), Dorothy Shockett (1), Lydia Zollenhofer (1), Margaret Witters (1), Cordelia White (1), Christina Seitz (1).

Names of students making problem II:

Christina Seitz (—1).
Dorothy Shocket (—1).
Irene Slaysman (+2).

Name of student first solving problem II: Bertha Wyner (2).

Names of students solving problem II correctly within the next two minutes:

Grace Stack (1),	Ray Zest (1),
Dorothy Webster (1),	Adele Seitz (1),
Cordelia White (1),	Marian Slaysman (1),
Mae Shockey (1),	Esther Wiley (1),
Margaret Witters (1),	Margaret Albert (1).

Names of students making highest score on the two problems:

Ray Zest (3).
Bertha Wyner (3).
Grace Stack (3).

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